Patented Mar. 9, 1954

2,671,717

UNITED STATES PATENT OFFICE

2,671,717

CHEMICAL BRIGHTENING OF ALUMINUM

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No Drawing. Application August 29, 1950, Serial No. 182,146

5 Claims. (Cl. 41—42)

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The present invention relates to the chemical brightening of aluminum surfaces. More particularly, it relates to a method of chemically treating aluminum surfaces for the purpose of increasing their specularity.

The term "aluminum" as used herein includes pure aluminum, aluminum of commercial purity, and various commercially available aluminum alloys containing, for example, small amounts of manganese, magnesium, copper, etc.

Various methods have been known heretofore for brightening metal surfaces including the surfaces of aluminum articles for the purpose of improving their decorative appearance or imparting thereto a high degree of reflectivity for use as light reflectors, etc. Until quite recently the only commercially successful method of brightening aluminum articles was by anodic treatment thereof in a suitable electrolyte such as a solution of sulfuric acid. However, as such electrolytic methods are quite expensive in requiring considerable electric equipment, numerous attempts have been made to brighten aluminum surfaces by purely chemical means. Of these attempts the most successful known to applicant prior to his invention included the immersion of the aluminum article in relatively concentrated solutions of certain acids or mixtures of acids including nitric, phosphoric and acetic acids.

The present invention is based on the discovery that by immersing aluminum articles in certain hot alkali solutions containing nitrate or nitrite ions, brightened surfaces can be obtained which are comparable to those produced by any of the processes known heretofore, the method having the particular advantage of greater economy due both to the lower cost and the lower concentrations of chemicals employed. The solutions employed in the practice of the present invention essentially contain an alkali hydroxide and a soluble nitrate or nitrite. While some improvement in the brightness or reflectivity of aluminum surfaces can be obtained employing somewhat more concentrated solutions, it has been found that to obtain the maximum specularity, the chemical treating bath should contain from 1 to 6 oz. of an alkali metal hydroxide such as sodium or potassium hydroxide and from 2 to 6 oz. of an alkali, i. e., sodium, potassium or ammonium, nitrate or nitrite per gallon of water. A preferred bath is one containing from 1.75 to 3 oz. of sodium hydroxide or equivalent amount of potassium hydroxide and 3 to 3.75 oz. alkali nitrate or nitrite per gallon of water. As the alkali content of the bath there can be employed either

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commercial sodium hydroxide or potassium hydroxide or any of a number of the commercially available alkaline cleaners consisting essentially of an alkali hydroxide such as sodium hydroxide and small amounts of phosphates, silicates and the like.

Both the composition and the temperature of the bath are important to obtain maximum brightening action. For best results the temperature of the bath should be from 140° to 170° F. and at such temperatures an immersion time of from 2 to 4 minutes is usually sufficient to obtain the desired degree of brightness.

As removed from the alkaline bath, the aluminum articles are coated with the dark deposit characterizing aluminum articles which have been immersed in an alkaline solution. This dark deposit can be easily removed, for example, by immersion of the treated article in a nitric acid solution containing from 15 to 35% nitric acid, or in a solution of 15 to 25% nitric acid with ¼ to ½% hydrofluoric acid or by immersion in the usual sulfuric acid anodizing solutions employed for the purpose of anodizing aluminum surfaces to provide thereon a thin protective film of oxide. In general, it is preferable that all surface impurities be removed prior to anodization to assure the production of uniform brightness and protective aluminum oxide film. Even after anodization, the surfaces obtained in accordance with the present invention exhibit a total reflectivity for white light of from 72 to 78%, this value being somewhat higher for unanodized surfaces.

It is known that immersion of aluminum surfaces in hot solutions of sodium hydroxide followed by treatment with a suitable acid solution to remove the dark deposit will produce a uniform etching of the surface with the production of what has been described as a bright, etched surface. The process of the present invention differs from such etching processes in that a nitrate or nitrite forms an essential component of the treating bath with the result that there is obtained a brilliant, smooth, highly reflective and substantially unetched surface. For example, it has been found that when the bath consists only of the alkali hydroxide with no addition of nitrate or nitrite, considerable etching is noted and a finish is produced with some degree of brightness but which is not always uniform. However, with the addition to the bath of sodium nitrate or sodium nitrite of the correct concentration, a surface of high degree of brightness measured in light reflectance is uniformly obtained. It is believed that the brightened product obtained in accordance with the present invention results from a cleaning and a mild etching action by the alkali hydroxide content of the bath forming sodium aluminate, combined with the reaction of the nitrate or nitrite with the aluminum surface to keep the surface from oxidizing and overetching. Presumably, the nitrates or nitrites are reduced to ammonia while hydrogen is liberated due to the action of the caustic alkali on the aluminum with the production of sodium aluminate. The formation of alkali aluminate in the reaction tends to buffer the solution and reduces the tendency to overetch. The evolution of these reducing gases employing an optimum balance of the alkali hydroxide and nitrate or nitrite causes the maximum or optimum gassing of the surface to prevent overetching or overoxidation of the surface and, hence, the maximum brightening thereof.

As a specific example of the process of the present invention, aluminum articles were immersed in a hot solution containing two ounces sodium hydroxide and two ounces sodium nitrate per gallon of solution. The temperature of the solution ranged from 145 to 165° F. After an average immersion of about 3 minutes the articles were removed from the bath and the dark coating thereon removed by means of a sulfuric acid anodizing bath. After anodization to produce a coating requiring at least 200 volts to break through the oxide coating, the treated articles were found to have 72 to 78% reflectivity. The surfaces of the articles were uniformly bright.

What I claim as new and desire to secure by Letters Patent of the United States is:

1. The method of chemically brightening the surface of an aluminum article which comprises immersing said article in a hot solution maintained at a temperature from about 140–170° F. and consisting of water, an alkali metal hydroxide of the group consisting of sodium and potassium hydroxide, and an alkali nitrate, said solution containing from one to six ounces of the alkali metal hydroxide and from two to six ounces of the alkali nitrate per gallon of solution.

2. The method of claim 1 in which the alkali metal hydroxide is potassium hydroxide.

3. The method of claim 1 in which the alkali metal hydroxide is sodium hydroxide, and the alkali nitrate is sodium nitrate in the proportions of from one to four ounces sodium hydroxide and from two to five ounces sodium nitrate per gallon of solution.

4. The method of chemically brightening an aluminum surface which comprises the immersion thereof in a hot solution consisting of water, sodium hydroxide and sodium nitrate, said solution containing from 1.75 to 3 ounces sodium hydroxide and from 3 to 3.75 ounces sodium nitrate per gallon of solution, said solution being maintained at a temperature of from 140–170° F.

5. The method of chemically brightening the surface of an aluminum article which comprises immersing said article in a hot dilute aqueous solution maintained at a temperature of from 140–170° F. and consisting essentially of water, an alkali metal hydroxide of the group consisting of the hydroxides of sodium and potassium, and a compound selected from the group consisting of the nitrates and nitrites of ammonia, potassium, and sodium, said solution containing from one to six ounces of said alkali metal hydroxide and from two to six ounces of said compound selected from the group consisting of the nitrates and nitrites of ammonia, potassium, and sodium.

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References Cited in the file of this patent

UNITED STATES PATENTS

Number	Name	Date
1,247,086	Crowe	Nov. 20, 1917
2,068,352	Schlacks	Jan. 19, 1937
2,096,309	Pullen	Oct. 19, 1937
2,168,909	Mason	Aug. 8, 1939
2,171,546	Kappes	Sept. 5, 1939
2,311,623	Blackmun	Feb. 23, 1943
2,395,694	Spence	Feb. 26, 1946
2,502,621	Fine	Apr. 4, 1950